

Comparative Image Quality of Multispectral Fingerprint Images

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CTO & VP

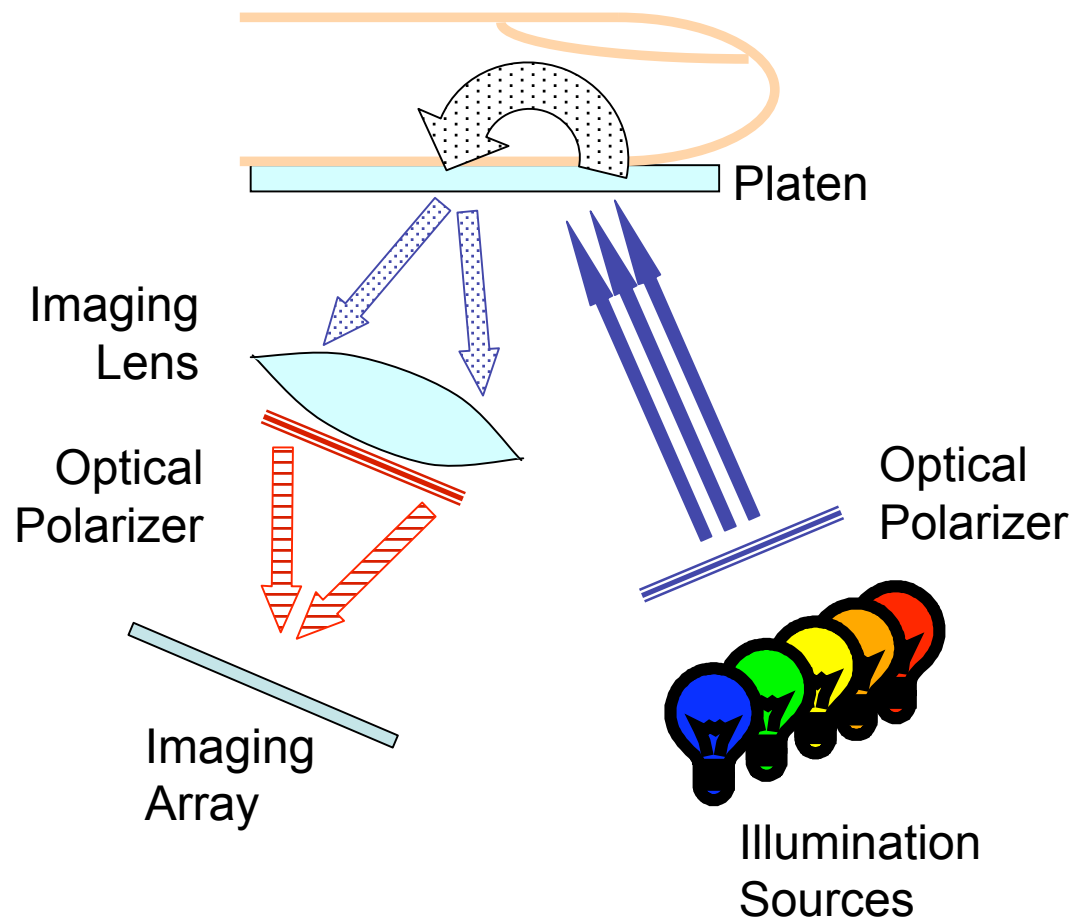
March 8, 2006

Topics

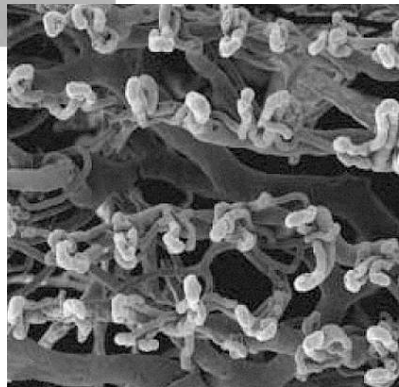
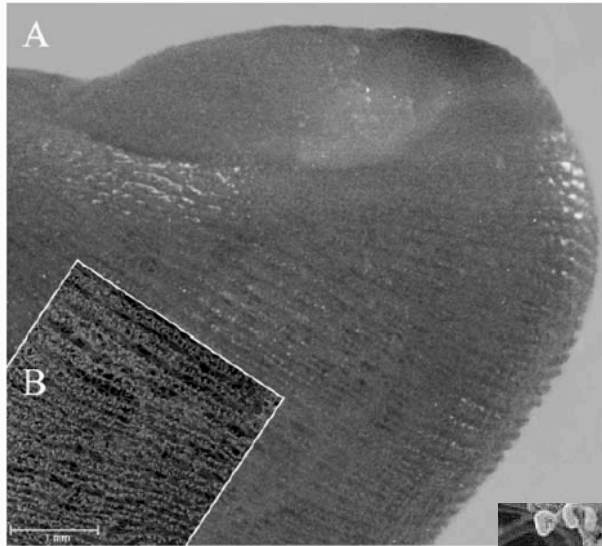
- Background
 - Multispectral hardware
 - Physiology
- Image quality
 - Qualitative study
 - Quantitative study
- Notes:
 - Comparisons are made to conventional optical imaging (TIR)
 - These studies are small; intended as motivational rather than definitive

Multispectral Imager (MSI)

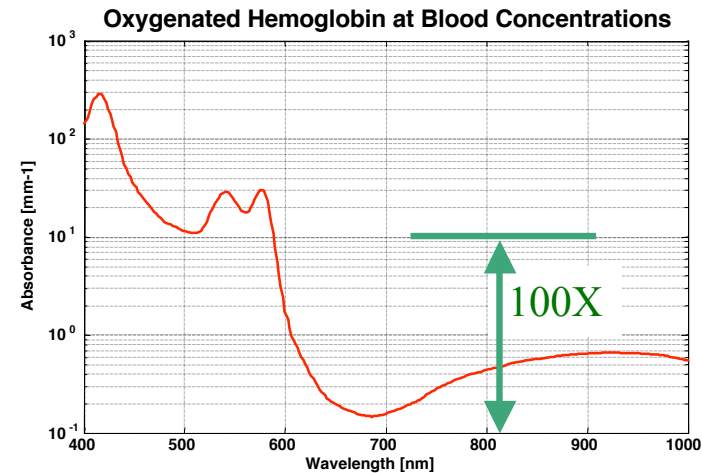
- Arrange optics to image skin surface and subsurface
- Collect a quick series of different images
 - multiple illumination colors
 - different polarization conditions



Multispectral Sensor Relevant Fingertip Physiology



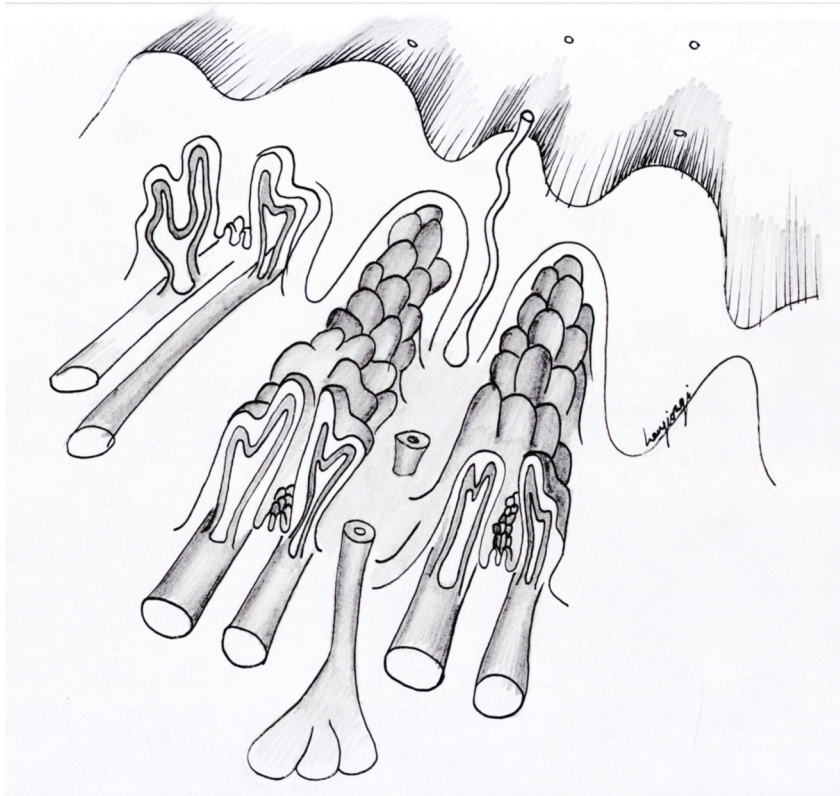
From S. Sangiorgi et al.,
“Microvascularization of the human
digit as studied by corrosion casting,” *J.
Anat.* 204, 123 – 131 (2004)



Optical absorption due to blood
(Note: semi logarithm scale)

The blood vessels and
other skin structures
provide an internal
fingerprint pattern

Further Physiological Details



Simone Sangiorgi, personal communication

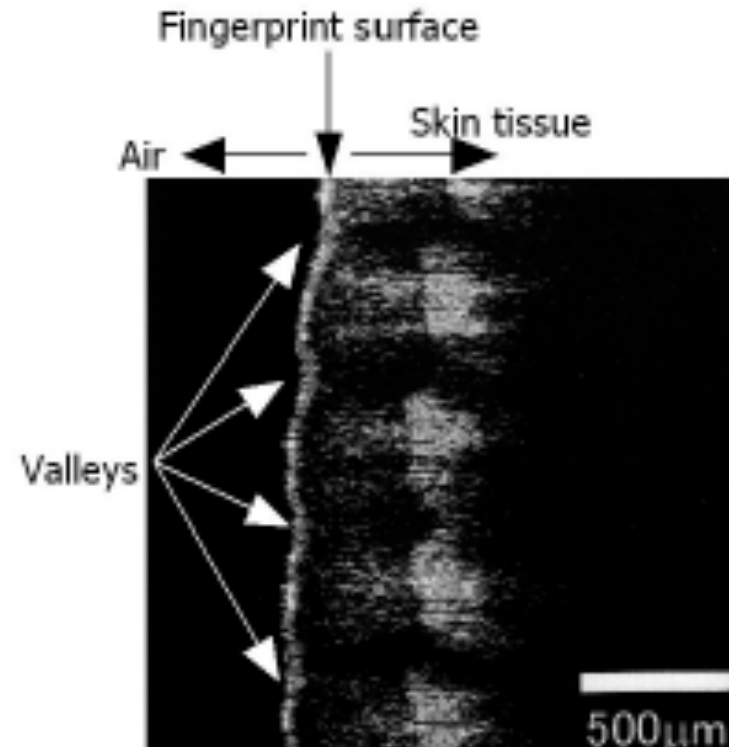


Image below a fingerprint using optical coherence tomography (OCT)

A. Shirastsuki*, et al, Novel optical fingerprint sensor utilizing optical characteristics of skin tissue under fingerprints, Proc SPIE 5686, 2005

Current Multispectral Configurations



Dual-Technology Sensor
for Civil Applications
(with Cross Match)

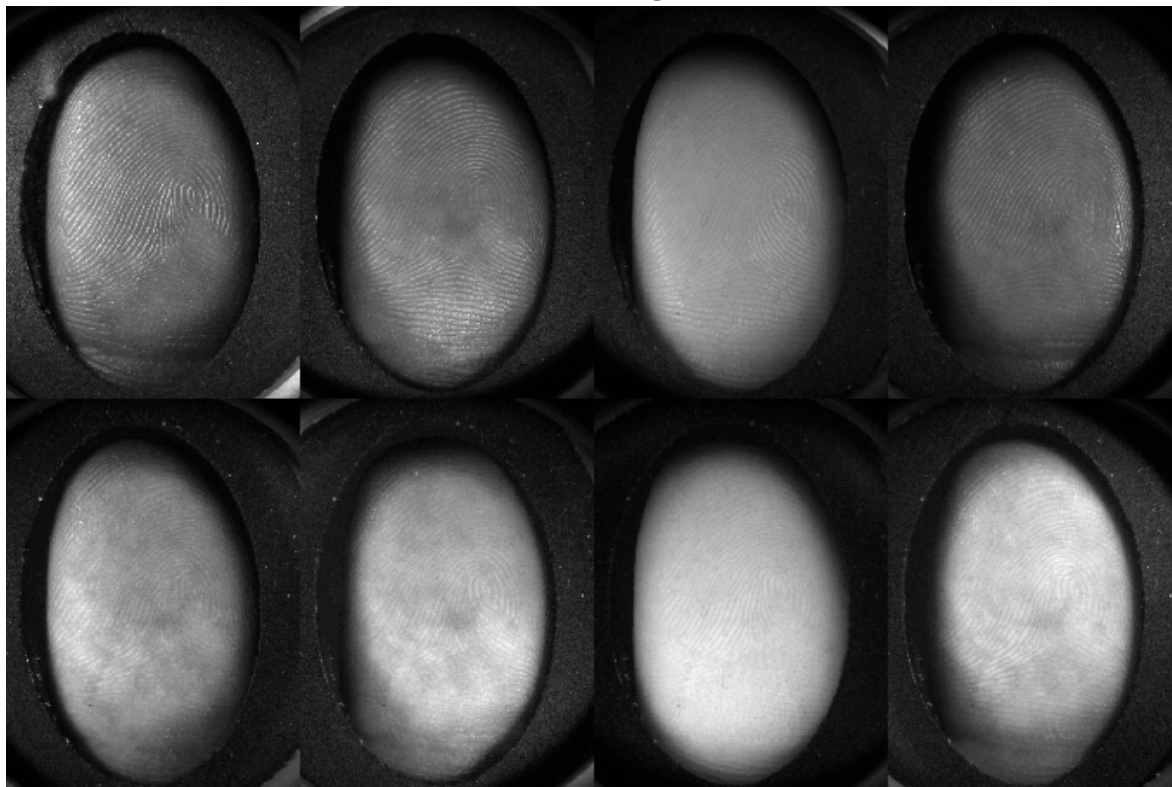


Multispectral Sensor for
Turnstile Entry into Theme Parks

Typical Data

Individual Planes and Composite Image

470, 530, 617nm and white-light, random polarization



470, 530, 617nm and white-light, crossed polarization



Performance studies

Study #1

- Example images of several different imaging conditions
 - Normal
 - Wet skin
 - Dry skin
 - Light contact
- Comparison made to conventional images measured contemporaneously
 - Identix DFR-2100

Normal Conditions

Conventional Images, Mean NIST Quality Value = 3.2

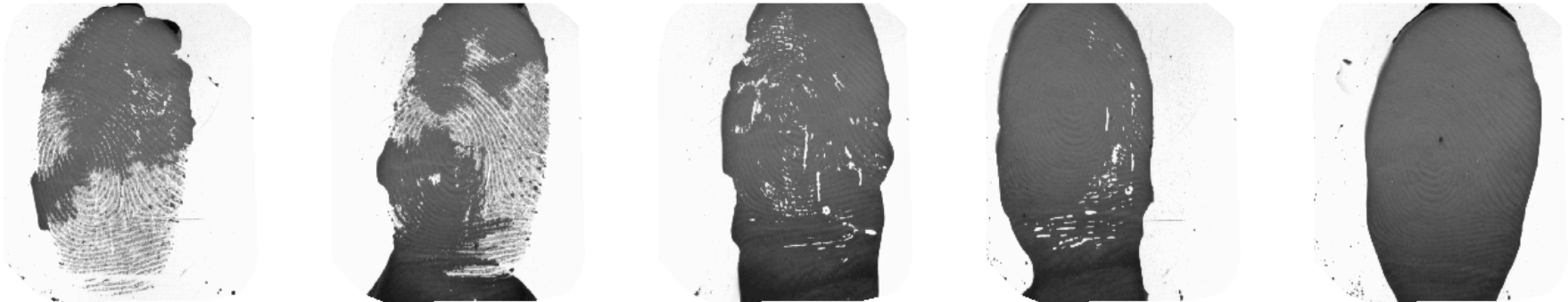


Lumidigm Images, Mean NIST Quality Value = 2.0



Water on the Platen

Conventional Images, Mean NIST Quality Value = 5.0

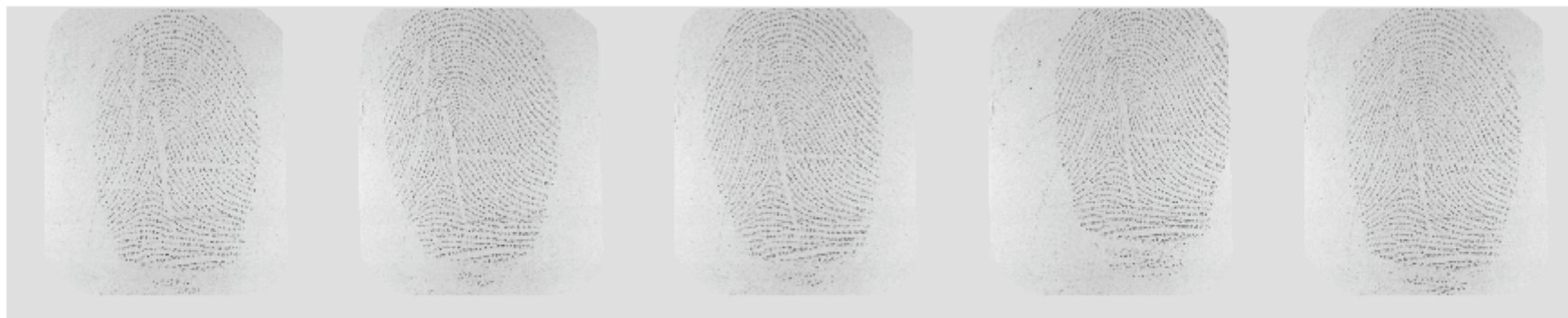


Lumidigm Images, Mean NIST Quality Value = 1.4



Dried Skin (With Acetone)

Conventional Images, Mean NIST Quality Value = 2.2

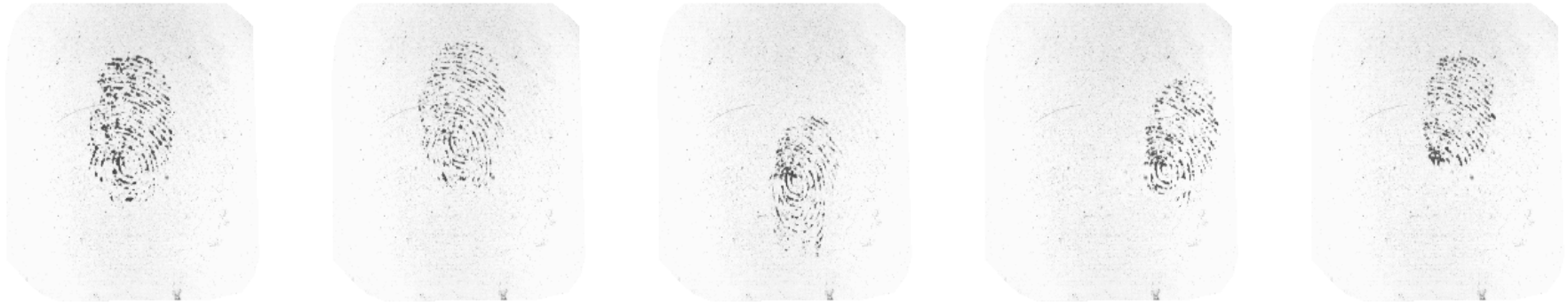


Lumidigm Images, Mean NIST Quality Value = 1.8



Light Pressure

Conventional Images, Mean NIST Quality Value = 5.0



Lumidigm Images, Mean NIST Quality Value = 2.0



Study #2

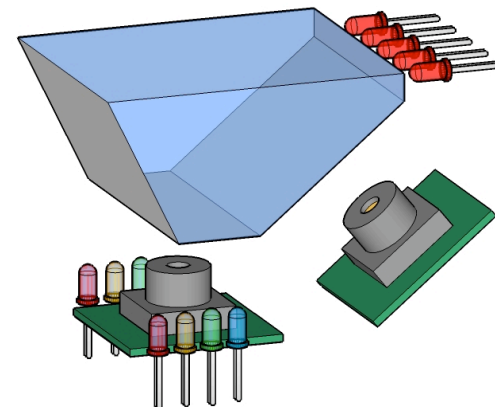
- Examine the relative biometric performance of two fingerprint image modalities measured simultaneously
 - Conventional
 - Multispectral
- Examine the relative NIST quality metrics

Biometric Performance Comparison Methods

- Use a dataset collected with the Lumidigm/CrossMatch 2-Camera Prototype
- Dataset consists of
 - 45 people
 - 184 unique fingers
 - 685 samples
- Reduce the 6 MSI image planes into a single composite image



Prototype of Lumidigm / Cross Match
two-camera sensor



Biometric Performance Comparison Results

- For this study:
 - TIR images produced an equal-error rate (EER) of 10.6%
 - The corresponding MSI images produce an EER of 2.9%
- Unqualified, single-sample enrollment
- Full round-robin assessment
- Dry, desert environment

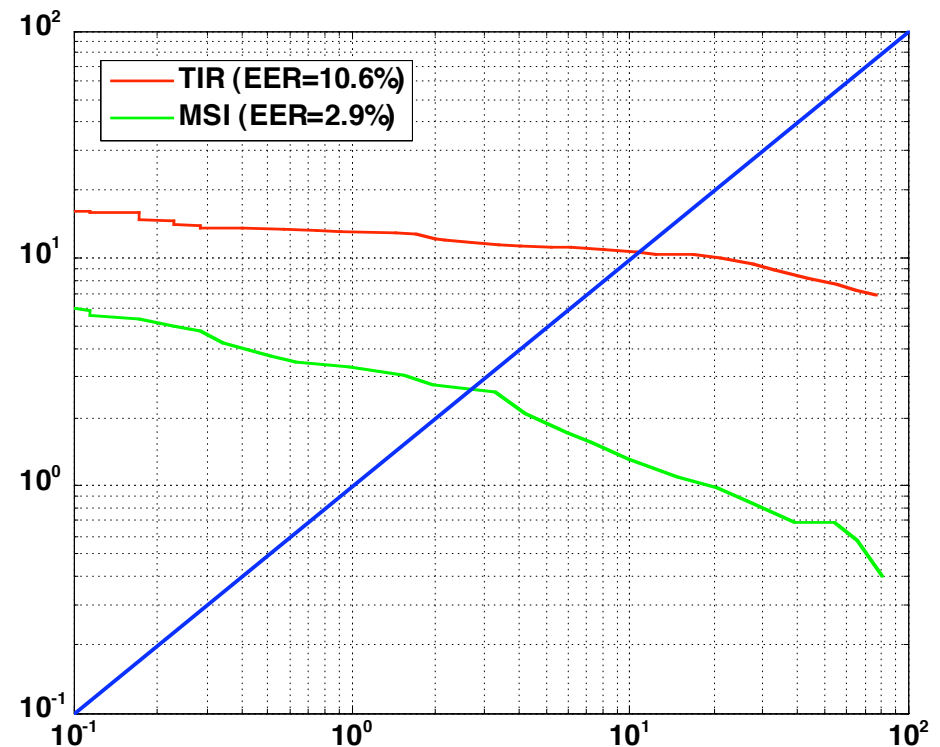
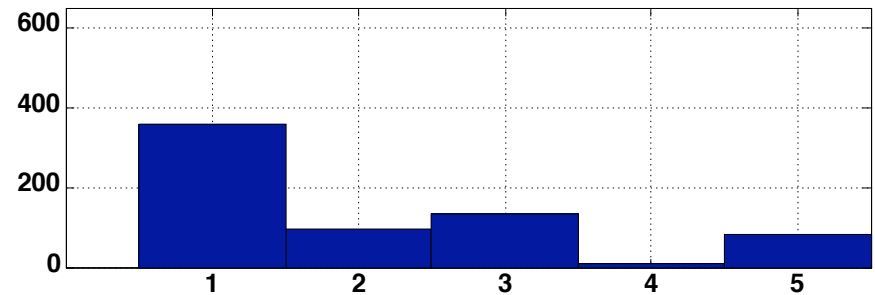


Image Quality Comparison Methods

- Apply the NIST quality algorithm (NFIQ) to each of the MSI and TIR images.
 - Values range from 1 \leftrightarrow 5, 1 is best, 5 is worst
- Accumulate and compare the respective histograms of image quality values

Image Quality Comparison Results

- TIR image quality shows a significant spread across the 5 quality categories
 - Mean = 2.06
- Corresponding MSI image quality is much more tightly clustered around the high quality category (1)
 - Mean = 1.25
- These results correspond well with the relative performance values
 - EER=10.6% vs. 2.9%



Summary and Contact Details

- Multispectral imaging technology has been designed to provide higher quality images over a wider range of conditions than conventional fingerprint imaging methods
- Initial studies have demonstrated this benefit of multispectral imaging
- Further (and larger) studies are underway to better quantify the improvements
- Contact information:
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